REMARKS/ARGUMENT

Claims 1-16 and 26 are pending after entry of this Amendment. Claims 1 and 10 are herein amended to positively recite that the inorganic dielectric layer/silicon dioxide layer has a dielectric constant of about 4, and that the carbon doped oxide layer is formed directly over the inorganic dielectric layer/silicon dioxide layer. Examiner is kindly directed to page 11, lines 6-10 of the specification as filed for support for the dielectric constant claim amendments, and to page 10, line 21-page 11, line 5, page 12, lines 6-8, and Figures 2-6 for the claim amendments reciting that the carbon doped oxide layer is formed directly over the inorganic dielectric layer/silicon dioxide layer. No new matter is introduced.

Rejections under 35 U.S.C. §102

Claims 1-4, 7-12, and 14-16 were rejected under 35 U.S.C. §102(e) as being anticipated by Liu et al. (U.S. Patent No. 6,211,063). Applicants respectfully traverse this rejection and request reconsideration.

Liu et al. teach a method of fabricating an integrated circuit with dual damascene structures. The Liu et al. structure includes a substrate (30) with a first metal layer (32) in a silicon oxide layer (34) formed thereon. A first silicon oxynitride layer (35) is deposited overlying the first metal layer (32) and silicon oxide layer (34). A low-k value dielectric (36) of fluorinated silicate glass (FSG) is deposited over the first silicon oxynitride layer (35), and a second silicon oxynitride layer (38) is deposited over the low-k value FSG layer (36). The second silicon oxynitride layer (38) is patterned and etched for later feature (60) formation. A layer of hydrogen silsesquioxane (HSQ) (46) is deposited over the second silicon oxynitride layer (38), and a layer of plasma enhanced silicon dioxide (48) is deposited over the HSQ layer (46). A trench feature is first formed in the HSQ layer (46) (Figs. 7-8), and then a via feature is formed in the FSG layer (36) (Figs. 9-10).

As described and illustrated by Applicants, independent claim 1 of the present invention, as amended herein, claims a method for making a dielectric structure for dual-

damascene applications. The method includes providing a substrate and fabricating metallization lines within the substrate. A barrier layer is formed over the metallization lines and the substrate. An inorganic dielectric layer to define a via dielectric layer is formed directly over the barrier layer. The inorganic dielectric layer has a dielectric constant of about 4 and is highly selective relative to the barrier layer when etched. A carbon doped oxide layer is then formed to define a trench dielectric layer over the inorganic dielectric layer.

In independent claim 10, Applicants claim a method for making a multi-layer inter-metal dielectric over a substrate. the method includes forming a barrier layer over the substrate, and then forming a silicon dioxide layer over the barrier layer. The silicon dioxide layer has a dielectric constant of about 4. A carbon doped oxide layer is formed directly over the silicon dioxide layer. A trench is formed through the carbon doped oxide layer, and a via is formed in the trench extending through the silicon dioxide layer to the barrier layer.

To anticipate a claim, the reference must teach each and every element, either expressly or inherently, of the claim. See MPEP §2131. Applicants respectfully submit that the patent to Liu et al. fails to teach each and every element of Applicants' independent claims 1 and 10 as amended herein. Specifically, Liu et al. fail to teach a method in which a carbon doped oxide layer to define a trench dielectric is formed ***directly*** over an inorganic dielectric layer or a silicon dioxide layer, and fail to teach forming an inorganic dielectric layer or a silicon dioxide layer over a barrier layer, the inorganic dielectric layer or the silicon dioxide layer having a dielectric constant of about 4.

Liu et al. teach "HSQ is used as a dielectric material herein because of its low k-value (sic)" (col. 4, lines 50-51). HSQ therefore is a low dielectric constant layer, although HSQ is not a carbon doped oxide layer, as claimed in Applicants' independent claims 1 and 10. Liu et al., however, also teach the deposition of a "second silicon oxynitride layer 38 [is] deposited overlying the FSG layer 36" (col. 4, lines 21-22), and therefore the HSQ layer *cannot* be formed **directly** over the inorganic dielectric layer as

claimed by Applicants. The method claimed by Applicants does not include the formation of a barrier between the inorganic dielectric layer/silicon dioxide layer and the carbon doped oxide layer, and does include the formation of the carbon doped oxide layer ***directly over*** the inorganic dielectric layer/silicon dioxide layer.

Liu et al. also teach that FSG is used for the layer that the Examiner corresponds to Applicants' inorganic dielectric layer/silicon dioxide layer because, according to Liu et al., FSG has a low k value compared to other dielectrics such as silicon dioxide (col. 4, lines 17-19). Applicants, however, have described the inorganic dielectric layer as an inorganic silicon dioxide (page 10, lines 21-22), having a dielectric constant of about 4 (page 11, line 10). Applicants have specifically differentiated between an inorganic dielectric layer/silicon dioxide layer having a dielectric constant of about 4, and the carbon doped oxide layer having a dielectric constant of below about 3. Liu et al. are essentially teaching two low k layers, and are not teaching Applicants' claimed invention. Therefore, Liu et al. fail to teach each and every element of Applicants' independent claims 1 and 10, and Applicants respectfully request this rejection be withdrawn. Dependent claims 2-4, 7-9, and 14-16, depending directly or indirectly from one of independent claims 1 or 10, recite the same features which are not taught by Liu et al.

Further, in independent claims 1 and 10 as amended herein, Applicants claim the formation of a carbon doped oxide directly over the inorganic dielectric layer/silicon dioxide layer. Just as Liu et al. fail to teach the formation of one layer directly over another, Liu et al. also fail to teach the formation of a carbon doped oxide. HSQ is not a carbon doped oxide. Although the Examiner is correct in noting that Liu et al. state in the Summary of the Invention that a "layer of an organic spin-on hydrogen silsesquioxane (HSQ) is deposited overlying the second silicon oxynitride layer," (col. 3, lines 23-24) no further use of the term "organic" is associated with HSQ in the remainder of the patent. HSQ is clearly not organic in its chemical properties, and Liu et al. do not disclose or suggest a desirability to use an organic material as a low-k dielectric. With specific reference to the HSQ layer, Liu et al. fail to teach, or suggest, any organic material, carbon-doping, or other process or procedure to fabricate an organic quality or

characteristic of the HSQ. The Examiner is particularly directed to col. 5, lines 17-32, of the reference where Liu et al. discuss the introduction of nitrogen gas to the standard chemistry and the resulting reactions. Carbon is integral to the reactions, and if, by way of example, a carbon-doped HSQ were to be used, the reactions and resulting polymer would be different than that described, and would be disclosed or suggested. They are not. While the term "organic" is used one time, and one time only, in the Summary of the Invention, HSQ is not an organic material, the use of the term "organic" is unclear and possibly in error, and no disclosure or suggestion of introduction of an organic quality is disclosed in the patent to Liu et al. Of course, even if it were, Liu et al. still fail to teach the formation of a carbon doped oxide directly over an inorganic dielectric layer/silicon dioxide layer. Liu et al. therefore fail to anticipate independent claims 1 and 10.

For at least the above reasons, Applicants respectfully submit that the patent to Liu et al. does not anticipate claims 1-4, 7-12, or 14-16, and request that the rejections be withdrawn

Rejections under 35 U.S.C. § 103

Claims 1-16 and 26 were rejected under 35 U.S.C. §103(a) as being unpatentable over Smith (U.S. Patent No. 6,277,733) in view of Usami (U.S. Patent No. 6,077,574). Applicants respectfully traverse this rejection and request reconsideration.

Smith teaches a barrier (422) over a conductor (420). A low dielectric constant layer (424) is formed over the barrier (422), and a hardmask (426) is formed over the low dielectric constant layer (424). Another low dielectric constant layer (430) is formed over the hardmask (426). While the hardmask (426) may be etched for via formation, when the vias are formed, the low dielectric constant layer (430) over the etched portion is removed (Fig. 2d). Therefore, Smith teaches a low dielectric constant layer over a hardmask over a low dielectric constant layer over a barrier over a substrate.

Usami teaches a process for forming a plasma CVD fluorine-doped SiO_2 dielectric film in which a feed gas is supplied to a plasma CVD apparatus. The feed gas

includes, among various gases, carbon and fluorine gases which are controlled independently of each other resulting in a silicon-based SiO_2 dielectric film doped with fluorine and carbon for a low dielectric constant value.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references when combined must teach or suggest all the claim limitations. (MPEP §2143). Applicants respectfully submit the Office has failed to establish a *prima facie* case of obviousness.

The combination of Smith in view of Usami would have to teach or suggest the fabrication of a dielectric structure for dual-damascene applications or a multi-layer inter-metal dielectric over a substrate including the formation of a carbon doped oxide layer directly over an inorganic dielectric layer/silicon dioxide layer. Smith teaches the formation of a barrier or hardmask layer between two low dielectric constant layers. Smith fails to teach the formation of a carbon doped oxide layer ***directly*** over an inorganic dielectric layer/silicon dioxide layer having a dielectric constant of about 4. Usami does not teach or suggest the formation of a carbon doped oxide layer ***directly*** over an inorganic dielectric layer/silicon dioxide layer having a dielectric constant of about 4. Examiner asserts Usami is combined with Smith in order to teach a carbon doped oxide layer, but the use of a carbon doped oxide layer in the method of Smith still results in a low dielectric constant layer formed over a barrier formed over another low dielectric constant layer formed over another barrier. Therefore, the combination of Smith in view of Usami fails to teach or suggest all of the claim limitations as recited by Applicants in independent claims 1 and 10. Further, the asserted combination fails to teach or suggest all of the claim limitations of dependent claims 2-9, 11-16, and 26, each of which depend directly or indirectly from one of independent claims 1 and 10. Applicants respectfully submit that claims 1-16 and 26 are patentable under 35 U.S.C. §103(a) over Smith in view of Usami, and request that these rejections be withdrawn.

Claims 1-4 and 7-16 were rejected under 35 U.S.C. §103(a) as being unpatentable over Wang et al. (U.S. Patent No. 6,255,735) in view of Usami. Applicants respectfully traverse this rejection and request reconsideration.

Wang et al. disclose a conductive layer (10) over which an etch stop layer (12) has been formed. A first dielectric layer (14) is formed over the etch stop layer (12), and a second dielectric layer (18) is formed over the first dielectric layer (14). The second dielectric layer (18) is a low k dielectric material that is spin-coated on the first dielectric layer (14). Wang et al. describe the first dielectric layer (14) as formed of a low k dielectric material with a k value of less than 4 (see col. 5, lines 32-35), and the second dielectric layer (18) also being comprised of a low k dielectric material (col. 5, lines 55). The second low k dielectric material is disclosed to require a different sensitivity than the low k dielectric material in the first dielectric layer (14) to at least one etchant chemistry (col. 5, lines 60-63), although it is not disclosed that one or the other layer needs to have the lower of the two low k values.

Wang et al., therefore, do not disclose forming an inorganic dielectric layer/silicon dioxide layer over a barrier, ***the inorganic dielectric layer/silicon dioxide layer having a dielectric constant of about 4***, and forming a carbon doped oxide layer directly over the inorganic dielectric layer/silicon dioxide layer. Usami is asserted to be combined with Wang et al. in order to achieve a carbon doped oxide layer where Wang et al. teach a second dielectric layer (18) being a low k dielectric material that is spin-coated on the first dielectric layer (14). Usami, however, does not teach or suggest an inorganic dielectric layer/silicon dioxide layer having a dielectric constant of about 4. Therefore, the combination of Wang et al. in view of Usami, does not teach or suggest all of the claim limitations as recited in Applicants' independent claims 1 and 10, as amended herein. Applicants respectfully request this §103 rejection be withdrawn

Claims 5-7 and 12-13 were rejected under 35 U.S.C. §103(a) as being unpatentable over Wang et al. in view of Usami, as applied to claims 3, 4, or 11 above, and further in view of *Wolf et al.*, ("Silicon Processing for VLSI Era, Vol. 1: Process

Technology," Lattice Press, 1986, p194). Applicants respectfully traverse this rejection and request reconsideration

As described above, the combination of Wang et al. in view of Usami fails to teach or suggest all of the claim limitations as recited in Applicants' independent claims 1 and 10. Claims 5-7 depend from independent claim 1, and claims 12-13 depend from independent claim 10, and therefore the asserted combination likewise fails to teach all of the claim limitations as recited by Applicants. The Office asserts that *Wolf et al.* either demonstrates that TEOS was known in the art at the time of invention, or that TEOS is obvious to be used in the formation of an inorganic dielectric silicon dioxide layer. Even if *Wolf et al.* can be used as a reference to cite the TEOS feature, the Office has failed to establish a *prima facie* case of obviousness in that the cited combination fails to teach or suggest all of the claim limitations as claimed by Applicants. Applicants therefore request that this §103 rejection be withdrawn.

Claim 26 was rejected under 35 U.S.C. §103(a) as being unpatentable over Wang et al. in view of Usami, as applied to claim 10 above, and further in view of Smith. Applicants respectfully traverse this rejection and request reconsideration

As described above, the combination of Wang et al. in view of Usami fails to teach or suggest all of the claim limitations as recited in Applicants' independent claim 10. Claims 26 depends from independent claim 11 and therefore the asserted combination likewise fails to teach all of the claim limitations as recited by Applicants. The Office asserts that Smith teaches the use of Ta/TaN to cover a surface within the via and the trench. Even if Smith can be used as a reference to cite the Ta/TaN feature, the Office has failed to establish a *prima facie* case of obviousness in that the cited combination fails to teach or suggest all of the claim limitations as claimed by Applicants. Applicants therefore request that this §103 rejection be withdrawn.

Applicants therefore submit that the pending claims 1-16 and 26, as amended herein, are patentable over Smith, Usami, Wang et al., and *Wolf et al.*, and the asserted combinations thereof under 35 USC §103(a), and respectfully request the rejections be withdrawn.

In view of the foregoing, Applicants respectfully request reconsideration of claims 1-16 and 26. Applicants submit that all claims are in condition for allowance. Accordingly, a notice of allowance is respectfully requested. If Examiner has any questions concerning the present Amendment, the Examiner is kindly requested to contact the undersigned at (408) 749-6900, ext. 6905. If any additional fees are due in connection with filing this amendment, the Commissioner is also authorized to charge Deposit Account No. 50-0805 (Order No. LAM1P106A). A copy of the transmittal is enclosed for this purpose.

Respectfully submitted,
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